PRIZE SUBJECTS PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1912.

GEOMETRY.—Grand prize of the mathematical sciences (3000 francs). The subject proposed for 1912 is the improvement of the theory of algebraic differential equations of the second or third order the general integral of which is uniform. No memoirs having been received on the question proposed for 1910, this will also be awarded in 1912. Francœur prize (1000 francs), for work useful to the progress of pure or applied mathematics; Poncelet prize (2000 francs), for a work on pure mathematics.

Mechanics.—Montyon prize (700 francs), for inventions or improvement of instruments useful to the progress of agriculture, or the mechanical arts or sciences; Fourneyron prize (1000 francs), for a memoir on the theory and experiment of air resistance, applicable to aviation. The question set for 1910 is also postponed to 1912. Boileau prize (1300 francs), for researches on the motion of fluids contributing to the progress of hydraulics. As an alternative, the funds may be applied to the assistance of a scientific man without means.

Navigation.—The extraordinary prize of 6000 francs, for work tending to increase the efficiency of the French naval forces; Plumey prize (4000 francs), for an improvement in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—Lalande prize (540 francs), for a memoir or work useful to the progress of astronomy; Valz prize (460 francs), for the author of the most interesting observation made during the current year; Janssen prize, a gold medal awarded for a discovery or work representing an important progress in physical astronomy.

Geography.—Tchihatchef prize (3000 francs), for the encouragement of exploration in the lesser known portions of Asia; Binoux prize (2000 francs), for original geographical work; Delalande-Guerineau prize (1000 francs); Gay prize (1500 francs). The question proposed for 1912 is the study of the tides of the earth's crust.

Physics.—Hébert prize (1000 francs), for a treatise or discovery concerning the practical employment of electricity; Hughes prize, for a discovery or work contributing to the progress of physics; L. La Caze prize (10,000 francs), for works or memoirs contributing to the progress of physics.

Chemistry.—Jecker prize (10,000 francs), for works contributing to the progress of organic chemistry; Cahours prize (3000 francs), for the encouragement of young chemists; Montyon prize (unhealthy trades) (prize of 2500 francs and a mention of 1500 francs), for a means of rendering a trade or calling less unhealthy; L. La Caze prize (10,000 francs), for the best work on chemistry.

Mineralogy and Geology.—Victor Raulin prize (1500 francs), for facilitating the publication of works relating to mineralogy and petrography.

Botany—Desmazieres prize (1600 francs), for the best work published during the year on cryptogams; Montagne prize (1500 francs), for memoirs on the anatomy, physiology, development, or description of the lower cryptogams; de Coincy prize (900 francs), for a work on phanerogams.

Anatomy and Zoology.—Savigny prize (1500 francs), for the assistance of young travelling zoologists, not receiving Government support, concerning themselves specially with the invertebrates of Egypt and Syria; Da Gama Machado prize (1200 francs), for memoirs on the coloured parts of the tegumentary system of animals; Thore prize (200 francs), for the best work on the habits and anatomy of one species of European insects.

Medicine and Surgery.—Montyon prize (2500 francs, and mentions of 1500 francs), for works or discoveries useful in the art of healing; Barbier prize (2000 francs), for a discovery useful in surgical, medical, or pharmaceutical science, or in botany in relation to medicine; Breant prize (100,000 francs), for the discovery of a specific cure for cholera, or, as an alternative, for the discovery of the causes of this disease, leading to its eradication; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; Baron Larrey prize (750 francs), for a work dealing with the subject of military medicine, surgery, or hygiene; Bellion prize (1400 francs), for works or discoveries useful in medicine; Mège prize (10,000 francs); Argut prize (1200 francs), for the discovery of a remedy for a disease at present incurable.

Physiology.—Montyon prize (750 francs), for experimental physiology; Philipeaux prize (900 francs), for experimental physiology; Lallemand prize (1800 francs), for researches relating to the nervous system; L. La Caze prize (10,000 francs), for the best work on physiology; Martin-Damourette prize (1400 francs), for a work on therapeutical physiology; Pourat prize (1000 francs), for new data on the utilisation and assimilation of albumenoids in food.

Statistics.—Montyon prize (1000 francs, and two mentions of 500 francs), for the best memoir on questions relating to statistics.

History of Sciences.—Binoux prize (2000 francs).

General Prizes.—Arago medal, Lavoisier medal, Berthelot medal, Henri Becquerel prize (3000 francs), Gegner prize (3800 francs), Lannelongue prize (2000 francs), Tremont prize (1100 francs), Wilde prize (one of 4000 francs and two of 2000 francs), for work in the fields of astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Longchampt prize (4000 francs), Saintour prize (3000 francs), for work in the physical sciences; Victor Raulin prize (1500 francs), for work in mineralogy and petrography; Bordin prize (3000 francs), for researches on determining sex in living beings; Houllevigue prize (5000 francs); Caméré prize (4000 francs); Jérome Ponti prize (3500 francs); prize founded by Mme. la Marquise de Laplace; Felix Rivot prize (2500 francs).

HALLEY'S COMET.

ALTHOUGH our British skies were so unfavourable for observations of Halley's comet, the almost constant flow of published results shows that those astronomers more fortunately situated in clearer atmospheres and lower latitudes reaped a rich harvest; some of the most striking results are briefly referred to below.

Among the favourably situated observatories, that at Johannesburg, the Transvaal Government Observatory, was one of the most favoured, and appears to have used its opportunities to the fullest possible extent. Brief notes have appeared in NATURE from time to time, but in Circular No. 4 the results to the end of June are described in full, and illustrated by some forty reproductions of photographs and numerous drawings of the nucleus and head on various dates.

The photographs are described by Mr. H. E. Wood, who, at the request of Mr. Innes, the director, employed the 10-inch Cooke lens, of 44·6 inches focal length, to photograph the comet on every possible occasion. This instrument is the one presented to the observatory by Mr. Franklin-Adams, and has two finders, one of which is mounted on swivels, allowing it to be moved in two directions; this device proved exceedingly useful for getting the whole of the comet on the plate when the length of the tail exceeded 8°.

On the original photographs the scale is 1° = 20 mm., but in reproducing them this has been slightly reduced, and varies, on the nine plates, between 19·2 and 14·2 mm. per degree.

Between April 11 and June 3 the weather conditions were very favourable, except for the occasional intrusion of the moon, and photographs were secured on forty-four dates. Their general excellence is emphasised by two unmounted, direct prints which accompany the circular, thus affording a comparison between original and reproduction. Seven of the photographs were taken by Mr. Mitchell, the others by Mr. and Mrs. Wood, and Mr. Wood describes each in detail.

The maximum lengths of the tail shown on the photographs are 17° on May 6 (60 minutes' exposure), 17° 15′ on May 14 (38 minutes), and 18° on May 30 (120 minutes), but in each case the image of the tail evidently extended beyond the edge of the plate. On June 3, however, 120 minutes' exposure failed to record more than 4° 30′ of tail.

The majority of the photographs show a composite tail in which a number of rays appear to emanate from a point immediately behind the nucleus, while the envelopes around the nucleus appear to form a cap over the tail. Extraordinary irregularities and contortions are shown on the photograph of May 21, which is an exceptional one. The first photograph of the series, taken on April 11, showed a fan-shaped tail 9 long after 4 minutes' exposure. This gradually increased, and on April 19 (37 minutes) a tail of 7° 45 long was depicted, which was straight for 4° and then appeared to be blown to the south quite suddenly, the remaining part being very faint. A very confused, intricate, and contorted tail was photographed on April 21, one bright streamer, forming the northern boundary, bending twice at right angles at about 45 from the head.

On May 4 the photograph which we here reproduce, from one of the direct prints, was taken with 30 minutes' exposure, and shows a tail 15° long to the edge of the plate. At 5° from the head the breadth was 1°, and the tail appears to be composed of a large number of overlying shafts with a central bright streak. The southern edge is slightly convex, and shows a number of delicate branches emerging from it with striking regularity; the northern edge is quite simple.

Later photographs show a great number of streamers, ten rays being visible near the head on May 8; but the tail was straight, no branching of the streamers being shown. Three days later the tail was bifurcated by a dark central space, along the north edge of which there was a bright ray; this division was accentuated on a later photograph taken on May 11. An elongation of the head appeared on May 12, when the envelopes about the nucleus extended to a distance of 1° behind it. The last photograph before transit was taken on May 16 with 12 minutes' exposure, and shows 9° of tail, which was 2° 5′ wide at a distance of 5° from the nucleus. The greater brightness of the envelopes on the southern edge is noticeable to a distance of 1° from the nucleus, and the tail appears quite simple, without rifts or rays.

FIG. 1.—Halley's Comet, May 4, 1910. Photographed at the Transvaal Observatory. Exposure 30 minutes.

After the transit, on May 21, a condensed stellar nucleus was shown on the photographs, and the envelopes on the northern edge were stronger than those on the southern. But on May 25 the envelopes were apparently symmetrical, and two days later the nucleus was very bright, and there was no visible condensation. On June 25 the head was much broader than the tail, and appeared to be granular, suggesting a very close cluster of small stars; this, Mr. Wood suggests, may be a photographic effect. Although on several photographs taken in June the head is described as being large, no mention is made here of the division of the nucleus as recorded by other observers.

The circular also contains a most interesting *resumé* of the measured lengths of the tail recorded visually by Messrs. Innes and Worssell. The greatest apparent length was on May 19, when the tail extended 150° from the assumed position of the head; the greatest length actually seen and measured, with the whole comet visible, was 107°, on May 17. As mentioned in an earlier circular, the eastern, or morning, tails were seen at Johannesburg three days after the transit of the comet, but Mr. Innes believes that a rupture took place before May 18, and that the eastern tails seen on May 21 were not then connected with the main body of the comet. Mr. Innes's testimony as to the magnificence of the comet is worth quoting here. He says:—" It may be said that it would require much imagination to desire a more impressive and brilliant spectacle than that presented by Halley's comet on the mornings of May 15, 16, and 17. It was indeed a 'Great Comet,' such as the writer had never seen before and can hardly expect to see again."

No less interesting are the notes regarding the general visual appearances between January 25 and July 6, but space will not permit mention of more than a few of them. A secondary nucleus was measured on April 16, and was then 12″, in position angle 48·3°, from the primary; this appearance of a second nucleus was not persistent, but was recorded, on and off, many times. The drawings from the visual observations are reproduced on Plates x. and xi., and form a valuable record of the innumerable changes in the various phenomena attending the comet during the apparition. On May 6 the head was decidedly yellowish, an appearance not noted before, and the tail apparently intercepted about half the light of the star B.D. +8·5°, reducing its relative magnitude by 0·8. The nucleus and bright coma were also recorded as decidedly yellow on May 12, when the jets from the nucleus had a most extraordinarily complicated appearance, which was accentuated on the succeeding day (see Nos. 31–34, Fig. 2).

After the transit the visual observations showed a stellar nucleus without jets or rays, which, however, developed later. The nucleus, too, changed and became multiple, and three nuclei were recorded on June 2. Later, the separate nuclei appear to have become diffuse, and on June 4 had the appearance of a large, out-of-focus double star, distance about 4″, almost resolved; the colour was still yellow. By July 6 the head, although much brighter in the centre, showed no stellar nucleus.

Father Goetz, of the Buluwayo Observatory, also contributes some notes of visual observations, and gives a sketch of the comet's head as seen on May 13; a peculiar feature is a much brighter segment of the inner envelopes immediately in front of the nucleus. Two faint stars were seen through the coma on May 21, and were not appreciably dimmed.

A number of meteorological phenomena were recorded by the observatory staff and by numerous correspondents. Especially interesting are the lunar-halo phenomena depicted on Plate xii., and the note that unusually high temperatures were recorded at the observatory during the time of the comet's passage.

Mr. Innes offers to lend, under suitable conditions, the original drawings reproduced on Plates x. and xi. to any recognised investigator who may require them.

The Utrecht observations of the comet are recorded by Profs. Nijland and van der Bilt in No. 4453 of the *Astronomische Nachrichten*. They give positions from December 3, 1909, to May 27, and a number of notes describing the various peculiar phenomena observed. They also record the yellow and orange-yellow colour observed early in May, and direct attention to the various shapes and position angles assumed by the head. The sketches made between April 29 and May 6 so nearly resemble, in their peculiar forms, those made by Bessell and others in 1835, that the present observers suggest that the great periodic comet has its own special physiognomy.

The same journal contains a record of the observations made by M. F. Sy at the Algiers Observatory. Positions are given for the period April 10 to July 10, and the various phenomena of the head and the tail are briefly described. Observations of Venus and the comet, as suggested by Prof. Birkeland, were made, under adverse conditions, on May 2, but no special phenomena were remarked. Similar duplications of the nucleus to those recorded at Johannesburg were observed on May 3, 8, and later dates, but only a single nucleus was seen on May 5. A notable recrudescence of brightness apparently took place on July 9, as compared with July 5 when a nebulosity, 1 in diameter, and no nucleus were seen. References to these alternating duplications of the nucleus are made in the December (1910) number of the *Bulletin de la Societe astronomique de France*, where MM. Millochau, Borrelly and others describe their observations. M. Jamain finds that the successive appearances are best explained by the supposition that the nucleus of the comet had a rotatory motion, with a period of about 21·5 hours.

In No. 4461 of the *Astronomische Nachrichten* Dr. J. Mascart reproduces three excellent photographs, and three drawings of the head, taken at his special observing station at Teneriffe during May and April respectively; the complicated structure of the head on April 16 and 18 is especially remarkable. But Dr. Mascart deals chiefly with the conditions of observation on a mountain site, and strongly emphasises the advantages which accrue from the establishment of an astronomical observatory in a clear atmosphere and at a high altitude, yet more or less readily accessible. Finally, he suggests the necessity for establishing an important and permanent international observatory on Mount Guajara, where he was stationed. Dr. Mascart gives more details, and discusses such matters as the zodiacal light, &c., in an article which appears in the December (1910) issue of the *Rivista di Astronomia*, Turin (vol. iv., No. 12, p. 585).

A note in the December (1910) number of the *Observatory* (No. 429) suggests that, as the comet has now sufficiently emerged from the sun's rays, a few more observations may be secured, even in European latitudes, before it finally disappears until August, 1985. An ephemeris for Greenwich midnight, and extending to the end of March, is given; as the declination is about 18° south, those observatories situated in the southern hemisphere will enjoy better conditions. At present the comet is apparently situated in the constellation Corvus, and is travelling slowly in a south-westerly direction; its position for December 31, 1910, is R.A. = 11h. 53·4m., dec. = 18° 12·7 south, but after January 11 it will again commence to travel northwards.

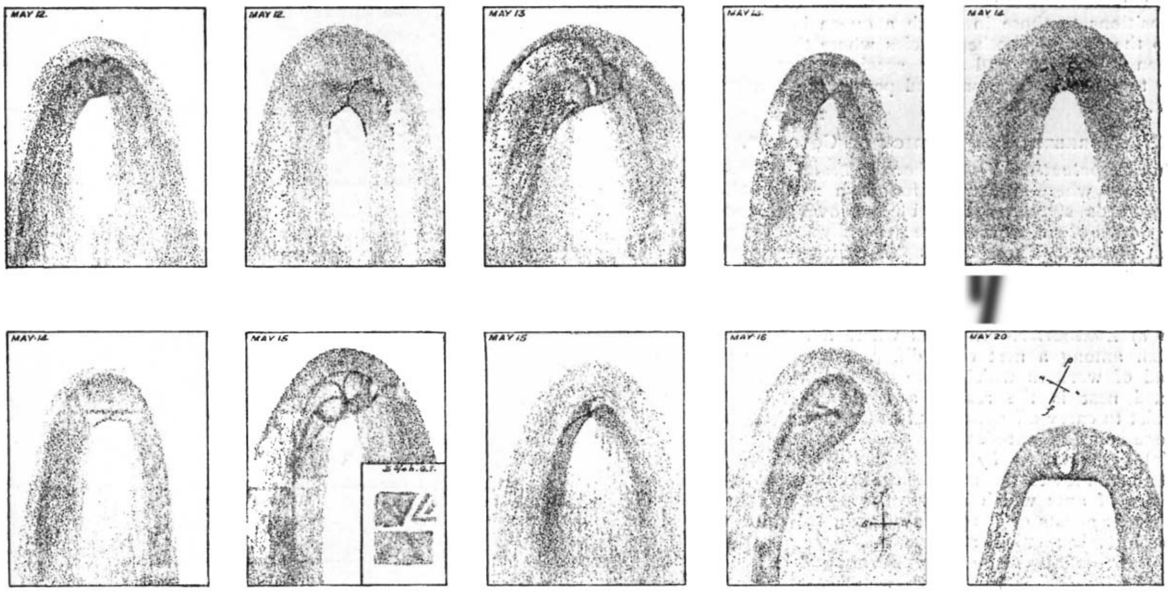

FIG. 2.—Changes in the Head of Halley's Comet, as observed at the Transvaal Observatory.

ON THE ORIGIN OF SLAVERY AND PARASITISM IN ANTS.

TWO interesting papers on the origin of slavery and parasitism in ants, by Henri Pieron, Maître de Conférences a l'Ecole pratique des Hautes-Etudes, have appeared recently in the *Revue générale des Sciences* (September 15 and 30, 1910), and the main points are summarised below. The papers are conveniently divided into sections, and are rendered more valuable by full references being given for all the statements referred to.

I. FEMALES: FOUNDATION OF COLONIES.

(1) *Foundation of a New Nest by a Fertilised Female.*—After the marriage-flight of ants, the males and females fall to the ground, when the males die, and those of the females which escape the numerous dangers to which they are exposed taken refuge in crevices in the ground, where they lay their eggs. For a month or more the female appears to subsist largely by the absorption of the alary muscles, now no longer required; but in some cases, as in *Atta sexdens*, the female carries with her a supply of the mycelium of an edible fungus, on which she and her progeny afterwards subsist. The earliest hatched workers in nests founded by a single female share her privations, being much smaller than those hatched later. In some cases a portion of the eggs are sacrificed for the nourishment of the female and the newly hatched larvæ, and are also used by *A. sexdens* as a hot-bed for the fungus. Some of the species of ants in which nests are founded by a single female are among the oldest in existence, going back, almost unchanged, to Tertiary times.

(2) *Foundation of a New Colony in a Pre-existent Nest.*—Female ants will sometimes take up their abode, and rear a fresh colony in the deserted nests of other species, or even, on more or less friendly terms, establish a colony of their own in inhabited nests of other species. On the other hand, ants of the genus Solenopsis, &c., usually form nests in small galleries round and communicating with the nests of larger species, which they plunder at will, without the larger ants being able to pursue them into their narrow fastnesses.

(3) *Foundation of a New Nest with the Aid of Workers of the same Species.*—The females of some ants are unable to form a new colony without the aid of workers, and if they fall to the ground near their own nest, or one of the same species, they may return to the nest, or may be joined by a colony of workers, and thus assisted to establish a new one.

(4) *Foundation of a New Colony with the Aid of Workers of another Species.*—Although ants usually